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A study of functional outcome of extra-articular displaced upper 3rd tibia fracture fixation with tibia interlocking nail with use of poller screw

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Abstract

Background: The tibia is the second longest bone of the body, located at medial side of the leg. Among all the fractures in the body, tibia is the single largest bone that is commonly involved in injuries. Owing to the increase in vehicular accidents and industrial mishaps, high velocity trauma produces tibial fractures in increasing numbers. By its location and by being subcutaneous in most of its length tibia fractures tend to be open very commonly. Due to its precarious blood supply and scanty soft tissue coverage orthopedic surgeons around the world have been fighting infections and union problems. Extra-articular upper 3rd tibial fractures account for 5–11% of all tibial shaft fractures. This study was performed to analyze nailing with aid of poller screw for upper 3rd tibia extra-articular fractures.

Objectives

- To analyze the possible benefits of use of poller screw in upper 3rd tibia to prevent malalignment.
- To study the duration of union in proximal tibia fractures with the use nailing and poller screw
- To establish the role of poller screw.
- To compare the results with published studies in term of hospital stay, mobilization, regaining normal range of movement and complications.

Methods: This study was carried out at Department of orthopedics, tertiary care hospital from June 2021- October 2022, inclusive of both. During this period 30 patients were identified with upper 3rd tibia fractures. Functional outcome was assessed using Modified Karlstrom- Olerud score (clinical assessment) & RUST (radiographic union scale for tibial fractures) score.

Results: 30 patient of upper 3rd tibia fracture were treated surgically with the use of Tibia Interlocking nail with use of Poller screw and the results were analysed functionally and radiologically.

Conclusion: Acquiring and conserving acceptable alignment needs adopting the right entry point, establishing adequate reduction of the fracture whilst reaming and nail insertion, securing appropriate route of reamers, utilizing a poller screw, and picking of suitable supplemental fixation like a plate or external fixation.

Keywords: Extra articular upper 3rd tibia fractures, Tibia Inter locking nail, Poller screw

Introduction

One of the most common injuries encountered in an emergency department are the tibial fractures. Incidence of tibial fractures is increasing due to rapid growth of industrialization and urbanization progressing year by year with rapid increase in traffic, incidence of high energy traumas are increasing with the same speed.

Concerning IMN, notably, malunion rates have been documented to be as high as 84%. In addition, diverse prior series showed detestable rates of fracture collapse, commonly into a procurvatum (anterior displacement) and valgus location. These prior bad outcomes led to surgeons moving aside from the usage of IMN for upper third tibial fractures. Nevertheless, with ongoing research facilitate the mastery of the specific anatomy and deforming forces around the upper third of the tibia besides the possible sake of prior weight-bearing and decreased soft tissue trauma, a newly renewed resurgence of IMN usage for upper third tibial shaft fractures has been detected.

Understanding these ideas permit for several successful methods, tips, and tricks to help keep reduction and restore native anatomy leading to recent studies exhibiting high rates of union and low resultant deformities after IMN.

It is known fact that upper 3rd and distal fractures of tibia favors to become into varus when managed with intramedullary nails or functional braces. Upper 3rd fractures of tibia tend to angulate into anterior bowing when secured with nail when fibula is intact. Intramedullary nailing for metaphyseal tibial fractures with short proximal and distal piece is associated with frontal and sagittal plane misaligned. This may be allocate to an incorrect entry site, dislodging muscular forces and residual deformity along with discrepancy between voluminous area of the metaphyseal-diaphyseal junction and size of nail. In lack of metaphyseal cortex contact, the nail may convert along interlocking screws, as a result of the play between screws and the nail holes. This may be limited with the help of blocking or poller screws. The blocking screws are placed so as to effectively reduce the size of the medullary canal proximally and thereby guide both the guide wire and the nail into an acceptable position. They can be placed in any plane but are usually placed in either the sagittal or coronal planes.

Poller screws acting as blocking screws, positioned alongside with the nail, have been suggested as a probable solution by preventing conversion in both the tibia and the femur. The term "Poller" is obtained from small metal appliances placed in roads to stop or guide traffic. In 1994 Krettek *et al.*

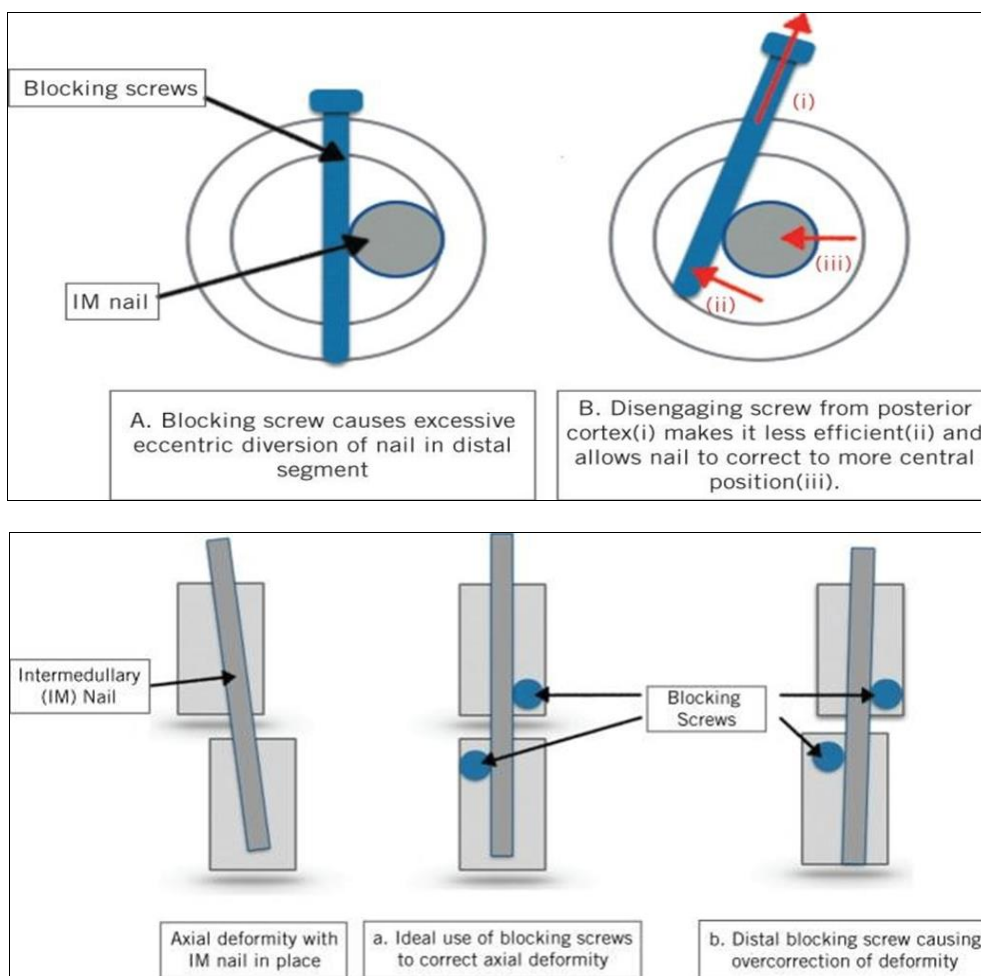
introduced the term poller screw. The concept of a poller screw is based on the principle that the malalignment induced by oblique, proximal and distal fractures can be counteracted by the nail-directing effect of the screw. Therefore, its position should aim to counteract the displacement of the fracture.

The nails are typically smaller than the intermedullary canal at proximal tibia in metaphyseal fractures at this level causing the segment to drift. Because the nail may not have dominant purchase on the proximal segment, by using blocking screw the effective canal of the nearby metaphyseal bits can be narrowed to an appropriate corridor for the nail to pass.

These Blocking screws reduces the diameter of the medullary cavity, actually stop the nail, and surge the mechanical rigidity of the bone-implant construct.

Furthermore, the big discrepancy between the area of the implant and the metaphyseal diameter multiplies the risk of mal-arrangement. In the absence of metaphyseal cortex connection, the nail may translate along the interconnecting screws, owing to the play between the screws and the nail holes. This can be prevented by the use of blocking screws or Poller screws.

Moreover, by placing a blocking screw from medial to lateral and having the nail pass anteriorly to this screw forces the nail anteriorly in the canal and can also prevent a sagittal plane deformity. One rule of thumb is to apply the screw on the depressed side of a malformation.



Materials and Methods

Study design is a hospital based prospective study and was carried out at SMIMER Hospital, Surat. 30 patients who were operated during June 2021 to October 2022 are included in

the study. During this period 30 patients were identified with upper 3rd tibia fractures based on inclusion and exclusion criteria.

Inclusion criteria

- Closed and open grade 1 & 2 extra-articular fracture
- Skeletally matured patient (Age>18 years)
- Male or Female
- Willing to participate in study
- Fit for anesthesia

Exclusion criteria

- Open grade 3 fractures
- Pathological fractures
- Previously operated fracture
- Neglected fracture
- Significant coexisting comorbidity

Case selection will be done in the criteria of history, clinical examination and radiological (X-ray and CT SCAN) examination.

Results**Table 1:** Age Involved

Age Group	Total number of patients	Percentage
18-20	04	13.33%
21-30	12	40%
31-40	10	33.33%
41-50	02	6.67%
51-60	02	6.67%
Total	30	100%

Out of the total 30 cases, majority of patients (40%) were within the age group of 21-30 years while 33.33% patients were in the age group of 31-40 years.

Table 2: Sex involved

Sex	Total number of patients	Percentage involved compared to total sample
Male	19	63.33%
Female	11	36.67%
Total	30	100%

From the data of chart given above, it is observed that out of 30 patients, majority were male 19(63.33%) while 11(36.67%) patients were female.

Table 3: Side Involved

Side	Total number of patients	Percentage
Right	16	53.33%
Left	14	46.67%
Total	30	100%

Right side was involved in 16 (53.33%) patients and the left side was involved in 14 (46.67%) patients in our study.

Table 4: Mode of Injury

Mode of injury	Number of patients	Percentage
Assault	10	33.33%
Fall from height	07	23.33%
Road traffic accidents	13	43.33%
Total	30	100%

In our study, mode of injury of 13 (43.33%) patients was Road traffic accident and 10 (33.33%) patients had history of

Assault and rest 07 (23.33%) patients had history of Fall from height.

Table 5: Injury-Surgery Interval:

Time	Number of Patients	Percentage
< 1 week	21	70%
1-2 weeks	06	20%
>2 weeks	03	10%
Total	30	100%

Most of the cases 21(70%) were taken up immediately for procedure within 1 week. However, 03(10%) patients were operated after 2 weeks.

Table 6: Association of Modified Karlstrum Olerud Score with use of Poller Screw and without use of Poller Screw

Method	Modified Karlstrum Olerud Score					Total
	Excellent	Good	Satisfactory	Moderate	Poor	
Poller Screw used	5 33%	8 53%	2 13%	0 0%	0 0%	15 100%
Poller Screw not used	0 0%	3 20.00%	9 60.00%	0 %0%	3 20%	15 100%
Total	5 16.66%	11 36.66%	11 36.66%	0 0	3 10%	30 100%

From the analysis of the data of this study, it can be observed that, in the most of the patients who were operated with Poller Screw, showed Excellent and Good results according to Modified Karlstrum Olerud Score. Adding to those 15 patients who were operated with Poller screw showed significant improvement compared to the other 15 patients

Table 7: Association of Union Status with use of Poller Screw and without use of Poller Screw

Union status	Poller Screw Used	Percentage	Poller Screw Not Used	Percentage
4-7 weeks	4	26.67%	3	20%
8-11 weeks	10	66.66%	7	46.67%
12-15 weeks	1	6.67%	5	33.33%
Total	15	100%	15	100%

In our study, majority of patients who were operated and Poller screw was used, had union at 8-11 weeks in 66.67% patients, while remaining patients who were operated but Poller screw was not used, had union time at 8-11 weeks in 46.67% patients.

Table 8: Association of RUST Score with use of Poller screw and without use of Poller Screw:

Rust score	Poller Screw Used	Percentage	Poller Screw Not Used	Percentage
1	0	0%	4	26.67%
2	5	33.33%	7	46.66%
3	10	66.67%	4	26.67%
Total	15	100%	15	100%

From the above values, it can be observed that significant association is seen between use of Poller screw and the RUST score.

Discussion

Long bones fractures establish the dominant part of emergency room techniques in most injury focuses. Of these long bone wounds, most commonly occurring are the fractures of tibia bone. The learning of the strategies for

treatment of tibial shaft fractures is essential, as tibial fracture is one of the most frequently occurring fractures of long bones, influencing for the most part young male population; entanglements, like re-surgery, non-solidification and poor union are additionally moderately normal.

In previous era of conservative management, slabs and casts were used for most of tibia shaft fractures. But their tendencies for malunion and nonunion were noted. In modern era, most of tibia shaft fractures are treated with intra medullary nailing. And over the years, it has been proved that surgical management is far better than conservative management.

From the results of this study, it clearly showed better union and alignment in Poller Screw group with intra medullary nailing, then non-Poller Screw group with intra medullary nailing in upper third shaft tibia fractures.

Mean age of our study group was 31.2 years. Out of 30 patients in our study 63.33% were male and 36.67% were female.

Given the distributed clinical information, intermedullary (IM) nailing procedures were created to limit damage to the fracture and connecting delicate tissues.

It has turned out to be standard consideration for the greater part of up-rooted tibial shaft fractures, however it has likewise been related with a few difficulties in these patients; in this way, some orthopedic specialists incline toward plate obsession for upper 3rd tibial shaft fractures. Insignificantly obtrusive plating systems lessens careful injury and keep up an all the more organically ideal condition for fracture healing.

In getting a tasteful decrease in both the coronal and sagittal planes. The rate of misalignment is accounted for to be as big as 58% for upper 3rd tibia cracks, 14% for distal tibias, 30% for proximal femurs and 10% for distal femoral fractures. Poller screws, initially portrayed by Krettek *et al.*, helped in acquiring tasteful arrangement amid medical procedure and give extra security. At the point when deliberately put, these screws manage the reamers and the nail to an appropriate direction, in this way accomplishing backhanded decrease. They additionally diminish the span of the medullary trench and increments the solidness of the bone-implant develop.

In the present study, most of the patients of the upper 3rd tibial fractures belonged to the age group of 21 to 30 years. 63.33 percent of the patients in our study were males. There was no case of nonunion at the last follow-up. In all, 12 of the 13 patients had postoperative fracture angulation which was less than 5° degrees in the coronal and sagittal planes. K wire functioned as Poller screw essentially as centralization of the nail and help to ensure reduction. The nail locking the in different directions, appropriate reduction can be maintained until the bone heals and there is no need for additional fixation material. Road traffic accident was responsible for upper 3rd tibial fractures in 43.33 percent of the cases.

Significant results were obtained while comparing the postoperative complications among subjects of two study groups. Valgus deformity was seen in 6 subjects of the non-poller screw group while only single subject of the poller screw group showed the presence of valgus deformity.

In the distal tibial fracture, a poller screw diminished twisting by 57%. Their investigation showed that inclusion of a poller screw near the osteotomy site enhanced the solidness of the build. The screws were embedded following the reaming procedure, contingent upon the fracture arrangement. In two cases, a 3.5-mm screw was utilized, while in whatever is left of the breaks, a standard interlocking screw was chosen. One

patient in whom a 3.5-mm screw was utilized, the screw twisted amid the nailing system. Every one of their patients in whom a poller screw was utilized had under 58 of precise deformation. Just a single patient, who did not have a poller screw embedded, had movement of valgus deformation from 68 to 108 valgus. Stedtfeld *et al.* planned a mechanical model to show the impact of a poller screw, which they named a 'trans-medullary bolster screw'. deformation. The single screw builds up the third purpose of three-point obsession of the sections. In the case where the nail has deficient safe haven to the shorter portion, or if the passageway purpose of the nail is too substantial, three-point obsession might be accomplished by utilizing a second screw on the curved side of the deformation a long way from the fracture. The creators have utilized this method for fracture of the proximal humerus, subtrochanteric femur and the distal femur, and the proximal tibia and distal tibia.

There's a high frequency of malalignment announced in writing while adjustment the fractures of the proximal and distal tibia. This malalignment is because of strong powers around the fractures which uproots it. Additionally, as a result of poor bone-nail contact in the meta-diaphysis and nails with securing screw openings put a solitary coronal plane, unsteadiness results because of play of a nail along the interlocking screws, causing varus-valgus malalignment.

Conclusion

From the above results, it can be concluded that Intramedullary nailing of metaphyseal fracture demands meticulous preoperative planning and approach of numerous methods to attain fracture reduction. Acquiring and conserving acceptable alignment needs adopting the right entry point, establishing adequate reduction of the fracture whilst reaming and nail insertion, securing appropriate route of reamers, utilizing a poller screw, and picking of suitable supplemental fixation like a plate or external fixation. Planned placement of poller screws aid to add on firmness to the fixation and intercept postoperative malalignment.

While there is theoretical possibility of strain hike results of poller screws, this method is uncomplicated to put in and should be considered as a part of the surgeons' armamentarium for nailing metaphyseal fractures of the tibia. Poller screw can be used as a tool for obtaining and maintaining reduction while treating displaced proximal and distal shaft fractures with intramedullary nailing.

However, this study is not enough and we need more patients for analysis. Larger study is needed to conclude effectiveness of Poller Screw in displaced upper 3rd tibia fractures.

Conflict of Interest

Not available

Financial Support

Not available

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